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APPLE SCAB IN THE POTLATCH.

BY LOUIS F. HENDERSON.

DEMOCRATIC-TIMES' JOB ROOM,
Moscow, Idaho.
1899.

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Bulletins.

The regular bulletins of the Station are sent free to all who request them. Bulletins issued since the close of the fiscal year June 30, 1898:

16. The San Jose Scale in Idaho.
17. Construction and Management of Hotbeds.
18. Sugar Beet Investigations in 1898.
19. Miscellaneous Analyses.
20. Apple Scab in the Potlatch.

SPRAYING FOR APPLE SCAB.

Preliminary Experiments Conducted in the Potlatch District of Northern Idaho.

Ever since the apple was first planted in Northern Idaho, it has been the almost universal opinion that this tree would be exempt from the numerous enemies, insect and fungus, that attack it in other localities. The reasons for this belief were manifold, the most reasonable being the dryness of the climate during the greater part of the summer, the altitude of about 2500 feet above sea level, and the fact that practically no pome fruits are shipped into the district. Several years ago, however, the fruit growers began to realize that this very pleasant hallucination had to be abandoned for the stern reality that enemies of various kinds were attacking the orchards and vineyards, and that the care and labor necessary to their suppression were as essential here as elsewhere. First came the San Jose Scale, spreading up and down the Snake and Clearwater Valleys, with the result that where proper spraying has not been done, quantities of fruit trees have been either killed by the scale or cut down as too infested for further productiveness. Then came the Codlin Moth, so that an orchard absolutely free from this pest is a rare thing in Northern Idaho. About the same time many vineyards became more or less infested by the Powdery Mildew, and occasionally in the peach orchards the Brown Rot made its appearance. Although the apple orchards of California, Oregon and Washington, especially in the region west of the Cascade mountains, had been severely injured in production by the Apple Scab, it was thought quite generally that the very fact that this disease had not

appeared in Northern Idaho while other insect and fungus diseases were becoming quite prevalent was sufficient evidence that it could not become acclimated in our dry, cool altitudes. The writer himself was almost persuaded that such was the case, after vainly looking for evidence of the Apple Scab in this section of the country during many previous years, when in the summer of 1897 several apples from the celebrated Potlatch district, probably one of the best apple producing sections in the world, were sent in for his examination as affected by some trouble unknown to the senders. Immediately the disease was pronounced "Apple Scab," and an examination made as to its prevalence in that district. It was found quite generally introduced, in some orchards very markedly so, in others very slightly, only an apple or a leaf here and there showing the characteristic blotches.

A few words of description of this unique region may not be out of place, a region wonderful in its scenery and flora, of a surprising fertility, and of great extremes in altitude and consequent varities of crops. Through the center of this region the Potlatch River and its numerous tributaries, Cedar Creek, Pine Creek, Bear Creek, the Middle and Little Potlatch Creeks, have cut such deep canyons that while the land along the tops of the cuts is at an elevation of 2500 feet, the bottoms of these rifts are only 800 to 1000 feet above the sea level. A wonderful variety in productions is the natural result. On the rolling lands above the canyons, apples, pears, prunes, cherries and the smaller fruits of the temperate zone together with wheat, oats, barley, white beans, potatoes, and many others, produce splendid crops. At the bottoms of the canyons, beside the fruits above mentioned, peaches, watermelons, cantaloupes, European grapes, apricots, field and sweet corn produce crops unexcelled anywhere for quantity and flavor. While much of the land on the sides of these canyons is too steep or too rocky for cultivation, and while the amount of land at their bottoms is very limited owing to the narrowness of the gorges, the rolling hills on their tops extend for many miles in every direction and are nearly all composed of fertile land, almost every foot of which can be cultivated. While the main industry at present is wheat

production, the time is not far distant when this will cease to be the case, and then more diversified farming and especially the raising of hardier fruits will be the almost universal rule. Even at the present time there is scarcely a farm in this whole district that does not boast of its little orchard, in a more or less perfect state of cultivation. In all these orchards the paying fruit is the winter apple. This being the case it is with considerable chagrin that our station workers have noted the advance of those twin foes of the apple grower, the Codlin Moth and the Apple Scab. Even at present their inroads have been so slight compared with most regions of the United States that the orchardists of the Potlatch and Palouse districts have paid and are paying very little attention to the one or the other. To the most superficial observer at all interested in horticulture it is apparent that both of these drawbacks to successful apple growing are *here*, and here to stay; the amount of their damage can only be estimated as years go and both pests become more widely scattered. At present the scab has been seen on Fix and American Ridges to the west of the Potlatch, on the Little and Big Bear Ridges to the northwest of the Potlatch, and on the Potlatch Prairie to the east of the stream. A most peculiar feature of its prevalence is, that while so common up and down the Potlatch, not a single orchard have I seen containing scab along the Clearwater, into which the Potlatch flows,—a district about the city of Lewiston containing the oldest orchards in Northern Idaho. When it is taken into consideration that the orchards of this valley, as well as those of the Snake, are only possible under irrigation, the absence of scab is the more remarkable. It would seem from this that the very hot, dry weather in late spring and throughout the summer and early fall must be largely responsible for its absence. In the Potlatch region, the centers of distribution seem to be in the neighborhood of Juliaetta and along Pine Creek. At least in no other places has the writer seen the orchards so badly affected. From these localities the disease seems to have radiated up the canyons and over the hills, till it has extended eight or ten miles in every direction. Not a case of its presence has come under

my observation anywhere in the neighborhood of Moscow in the Palouse Country. This immunity I think due only to the comparatively young orchards of this district and to the slowness with which the disease seems to travel in this whole region. Apple-raisers should therefore be on the lookout for it.

DESCRIPTION OF THE DISEASE.

That the farmers who may not have become acquainted with scab in other parts of the country, especially in the great apple-producing states of New York, West Virginia, Illinois and Missouri, may recoginze the enemy when it appears, a short description is here given. The accompanying cuts will also appeal to the eye in a more effective manner.

The Apple Scab has been known for many years in Europe and America, more recently in Australia, and has been given various names, such as "apple scab" and "black spot" upon the fruit; "leaf blight" and "leaf mildew" upon the leaves. The first name is the one generally accepted today, whether for fruit or leaves. The disease is due to a parasitic fungus, known scientifically as "Fusicladium dendriticum." A nearly identical fungus, not however found by the writer in this country, exists in many parts of the Eastern States on the pear. Its life history may be briefly given as follows. At many places upon the apples and leaves in an infected orchard spots begin to appear, even before the apple is half grown. Upon the apples the spots are nearly always circular, at least before several have grown together, of a greenish black color, with a light colored or whitish, narrow edge. Upon the leaves the disease first makes itself known by lighter green, puckered spots, which later in the season become smoke-colored or brownish-green. At times a velvety appearance is given the spots upon both apple and leaf caused by the rapid growth of the fungus. If examined under a good microscope the spots will be seen to be made up of fungus threads spreading in every direction, much branched and crossed by partition walls. This is called the "mycelium" of the fungus and answers to the stem and branches of any common plant. At almost any and all places

along the mycelium upright short branches arise, called "conidiophores," and on the ends of these "conidiophores" arise the spores or "conidia." These are little, brown, one or two celled bodies which have a pear, egg, or more commonly elliptical shape. They separate readily from the conidiophores when ripe (so readily that you may examine several slides under a microscope and see nothing but the stalks from which the conidia have dropped,) are blown off by the wind and thus carried to the fruit leaves and branches of unaffected trees. These spores germinate readily in water after the lapse of only a few hours. It can thus be seen that the only factors necessary to the successful reproduction of this fungus in unlimited quantities are, winds, the apple tree upon which it grows called the "host," water in the form of rain, fog, or heavy dews, with some warmth. As soon as the spores find lodgment upon the buds, leaves, or fruits of the apple, and the temperature be raised, as it is in the early spring, to a degree which will permit of germination of the spore, growth will begin. What this degree of temperature is has not been ascertained as far as the writer is aware. Certain it is, however, that it is so low that apples stored in bins in the east have been infected from fungus-bearing apples in the middle of winter. Germination in the spore consists in sending out a mycelial tube, like that of its parent, which bores its way through the outer skin or cuticle of the apple or leaf, and gets its support from the juices contained in the epidermis and neighboring cells. The mycelium of the fungus is therefore mainly *superficial* for it never burrows down into the tissues of the apple proper, but lives just between cuticle and epidermis. Under the microscope frequently several rows of the cells of a vertical section are seen to be brown and dead, but this is due to the fungus depriving them of their juices, and not to the *presence* of the fungus in the under tissues. It is important to remember this fact when dealing with "scabby" fruit, or when treating the tree with sprays. In the first place the scab being but superficial, the keeping qualities of the affected fruits may not be interfered with if the fruit has been infected by the fungus when nearly grown. If, on the other hand, as is

more frequently the case, the apple is infected when it is small, often when no larger than a pea, it will cease to grow, or the part affected will become one-sided or otherwise distorted, and frequently crack open in several places along the atrophied portion. Such cracked apples are then almost as liable to the attacks of moulds and other fungi, as if they were wounded by a fall or by the borings of the larva of the Codlin Moth. Such cracks are plainly visible in many of the apples shown in plate II. In the second place, the fungus being superficial, it is much more easily treated, or rather yields much more readily to treatment, than many fungus diseases which live within the tissues of the host. For both of these reasons combined, it is never to be compared in noxiousness with the San Jose Scale or the Codlin Moth. In many orchards this pest has been practically exterminated after one season's spraying consisting of two or three applications carefully applied. While this is the case in sprayed orchards, the losses in many states where little or no spraying was once the rule, have been very heavy from this cause alone. In Illinois the loss from scab was estimated by the Secretary of the Illinois Horticultural Society at $400,000 for one year. In Kansas the loss was put as high as one-fourth the crop; in Indiana it was put at one-sixth the crop; while in Missouri it reached one-half the crop. Although this disease has been in the Potlatch district but a few years, at one orchard on Pine Creek this present year fully nine-tenths of the apples were scabby, and not more than one-half would rank first-class, irrespective of the Codlin Moth and considering this disease alone.

TREATMENT.

Various fungicides have been recommended in combating the apple scab, but three have so far surpassed all others that attention will be directed to these alone. They are 1st, a solution of Copper Sulphate, commonly called "Bluestone;" 2nd, Bordeaux Mixture, and 3rd, Ammoniacal Copper Carbonate, or as it is commonly known at present among the initiated "Cupram." I shall briefly discuss each.

Sulphate of Copper Solution.

This is a very common spray, but it can only be applied when the tree is in a *dormant* condition. It *should never* be applied when the leaves are on the plant, for it will severely burn and injure the foliage. The formulas are:

Sulphate of Copper.....4 lbs.
Water.....45 gals.

Or a weaker solution:

Sulphate of Copper.....1 lb.
Water.....18 gals.

This is a much better spray to apply to apple trees when in the dormant condition, as the crystals melt perfectly in water and no clogging of the nozzle can occur. If a large orchard is to be sprayed, many pounds of the bluestone can be dissolved at one time, and a "stock solution," as it has been called, can thus be made. To do this, take a large tub or barrel that will hold comfortably, say thirty gallons of water. In this we can dissolve thirty pounds of bluestone, when we will have a solution each gallon of which will contain one pound of bluestone. Four gallons of this solution can then be placed in a large barrel and enough water added to fill the barrel. It is then ready for use.

Two things are to be noted in the use of bluestone. First, the crystals will melt very much quicker in hot than in cold water. Second, it should not be dissolved in metal vessels, but in wooden, as the substance is intensely corrosive and will soon eat through metal tubs or pots. For the same reason the pump should be cleaned out by pumping clear water through it at the end of each day's use, while the piston should be oiled many times a day.

Bordeaux Mixture.

This is the most general spray for fungus diseases extant, as it can be applied at any time without injury to leaves or fruit; while it can be used upon any plants at the usual proportions, save upon the stone-fruits, such as peaches, when it must be used in a more dilute form. It is commonly used in two degrees of

strength, one known as the twenty-two gallon, the other as the forty-five gallon formula. The first is composed as follows:

Sulphate of Copper.....6 lbs.
Unslaked Lime.....4 lbs.
Water .....22 gals.

The other and more usual formula is:

Sulphate of Copper.....6 lbs.
Unslaked Lime.....4 lbs.
Water .....45 gals.

This is considered generally safer while it is at the same time more economical. The prerequisites to good Bordeaux Mixture are:

1. Plenty of good, clean water.
2. That the lime shall not be air slaked.
3. That the exact proportions of each of the three components be known and adhered to.
4. That there be plenty of mixing vessels.

1st. It would be no inconsiderable saving in time if children or anyone unemployed in the spraying could keep a large water barrel filled while the sprayers are employed in spraying. Better than this, where there is a spring on the place and the ground slopes sufficiently, is to conduct the water from the spring by a series of V-troughs directly to the barrel.

2nd. If the lime has become air-slaked, that it is so invaded by moist air that the lime has all crumbled, it is useless for Bordeaux Mixture, as the proper chemical reaction will not take place when the lime and the bluestone are brought together.

3rd. It is very essential that no guess-work be used in making the mixture, especially in the relative proportions between the pounds of bluestone and gallons of water. The stock solutions of the bluestone-water and the lime-water or milk should be known at any minute.

4th. The vessels and implements needed are: (1) A two, three or five gallon bucket for measuring the bluestone solution and water, and one for measuring the milk of lime. (2) A large wooden tub or half barrel to hold your stock solution of copper

sulphate, and one to hold your lime solution. (3) A large tub with handles in which to mix the copper sulphate solution and the milk of lime. (4) A large whiskey barrel with a square hole cut in one end, sufficiently large to admit a hoe or other implement for stirring the mixture as well as to receive the Bordeaux from the tub without spilling, and yet not so large that the mixture will slop over when the wagon is being moved from place to place. I must say that the writer prefers stirring from time to time with a hoe rather than the many automatic devices so commonly used geared to the pump. (5) A square yard of wire gauze with moderately coarse mesh, say twenty or thirty to the inch, tacked over four strips of plank solidly nailed together. Through this, if it is carefully rinced at each using, both the milk of lime and solution of bluestone can be strained, and thus most of the fragments that clog the nozzle so provokingly be eliminated.

How to Make Bordeaux Mixture and Copper Sulphate Solution.

Put into a sack definite pounds of bluestone, and suspend the same from the side of a tub so that the bottom of the sack will be raised an inch or more from the bottom of the tub. Then pour into the tub as many gallons of hot water, or half as many, as there are pounds of bluestone, and in the space of an hour or so the bluestone will have completely dissolved. If cold water is employed to dissolve the bluestone, as many days will commonly be needed for this purpose as it would take hours with hot water. When all of the bluestone is dissolved, take two-thirds as many pounds of good lime and slake it in another tub. In doing this, no more water should be employed at first than just enough to keep the lime wet. If this point is observed, the lime will crumble much more rapidly and will form a finer "milk" than when much or all the water is poured on at first. At the same time enough water should be added from time to time to keep up a lively disintegration and reduction of the lime, and not allow it to "cake" from lack of water. When this reduction has largely taken place, pour on more water, agitating the mass during the

whole of the time with a hoe. In this way, providing the lime is good and well burned, there will be few "stones" left in the mixture, but the whole will be dissolved to the consistency of cream. Then add as many gallons of water, or half as many, as there are pounds of lime, and again stir up the contents vigorously with the hoe. Suppose we have dissolved thirty pounds of bluestone in fifteen gallons of water, and twenty pounds of lime in twenty gallons of water for stock solutions. It is evident that to form the Bordeaux Mixture recommended in this bulletin we must first take out three gallons of the bluestone solution to give us the required six pounds of bluestone, while we must take out four gallons of the milk of lime to give us the required four pounds of lime. If these two quantities be mixed together without further dilution, a thick pasty Bordeaux will be the result, which, when mixed with the remainder of the forty-five gallons of water, will be flaky and tend to stop up the nozzle on spraying. The six pounds of bluestone solution and the four pounds of milk of lime should be diluted to about ten or fifteen gallons each *before mixing*. Then upon pouring them together, while some one else stirs the material with a hoe, a fine, soft, blue mixture is the result, free from any coarse flakes and passing readily through the spray nozzle. This tub-full of Bordeaux should then be poured into the barrel, which has been previously placed in a wagon or upon a stone-boat or sled, and the barrel, which presumably holds about forty-five gallons, can be then filled with pure water, the whole being vigorously stirred all the while by the hoe which is dropped through the hole cut out in the head of the barrel. This hole, as said before, should be but little larger than the hoe itself otherwise a large part of the contents will slop out of the full barrel as it is being drawn into the orchard. I have found it desirable to strain the bluestone solution, as well as the milk of lime, through the wire strainer, for by this means little bits of sacking or of string found commonly in lime will be eliminated, objects which often prove more troublesome to the sprayer from lodging in the nozzle than do the bits of undissolved lime themselves. A simple test whether the Bordeaux is

made correctly is this. Dip the blade of a very clean, bright knife in the mixture leaving it there for about a minute. If it contains too much bluestone, and is therefore hurtful, a slight discoloration due to the copper will take place, the knife-blade assuming a reddish hue.

When the copper sulphate alone is to be used, as in the early spring before the buds have broken, a solution of four to six pounds of bluestone is placed directly in the barrel, the latter is filled with water, and the mixture is then ready for application.

How to Make "Cupram," or Ammoniacal Copper-Carbonate.

I can do no better than quote the recommdation of L. C. Penny, (Bulletin 22 of the Delaware Experiment Station,) who devoted much time to the preparation of this mixture. "To one volume of twenty-six degree Beaume ammonia (the strong ammonia of commerce) add from seven to eight volumes of water. Then add copper-carbonate, best in successive quantities, until a large portion remains undissolved. The mixture should be vigorously agitated during the solution and finally allowed to subside, and the clear liquid poured off from the undissolved salt. A second portion should then be made by treating the residue of the former lot with more ammonia diluted as before, then with the addition of fresh copper-carbonate, in every case with vigorous agitation or stirring. This method of making in successive lots will result in a richer solution of copper, at least, unless an unwarranted length of time be taken. This solution may be made in any suitable wooden or stone-ware vessel."

For those who prefer a definite formula to a more scientific method of mixture, the following will be acceptable.

Copper-carbonate ..... 5 oz.
Ammonia 26 degrees Beaume ..... 3 pints.
Water ..... 45 gals.

Dilute the ammonia as in the previous method, since this tends to dissolve the carbonate more readily.

This spray is frequently used, and were it not for the uncertainty in regard to purity and strength in its components, it

would probably be almost as common as the Bordeaux. Though in many plant diseases it has not proved as successful as the latter spray, in two respects it is certainly better. These are, (1) it sprays more easily, (2) it does not discolor the fruit. The reason for the first is that the materials used in this spray are perfectly dissolved, and consequently no clogging of the nozzle can occur. On the other hand, many buyers object to the coating of Bordeaux seen upon fruits which have been sprayed when reaching maturity. Although it has been proved by very careful chemical analyses over and over again, that no injury can befall anyone from eating the small amount of copper found upon fruit sprayed with Bordeaux, the slight discoloration or rather coating may be entirely avoided by using the "Cupram" for the last spraying in the spring or early summer.

In my experiments in Idaho I have used only the copper-sulphate solution and the Bordeaux mixture.

EXPERIMENTS FOR PREVENTING APPLE SCAB IN 1899.

As the scab occurs nowhere in the country directly surrounding Moscow, the orchard of Mr. John Aldrich, of Juliaetta, was selected for experimentation. The reasons for this selection were two-fold. In the first place, the orchard directly joins the village of Juliaetta, which town is in the valley of the Potlatch River and on the N. P. R. R. branch-line. Though twenty-five miles from Moscow, it was thus accessible by means of an hour's ride on the cars. This accessibility was increased through the generosity of the officials of the railroad company who gave the writer and his co-laborers free transportation to and from our field of operations throughout the spraying season. In the second place the orchard offers as many difficulties in the way of successful treatment as any with which I am acquainted in this whole section of country. The orchard is old and badly infested with both codlin moth and apple scab; the trees are planted very near together (only twenty feet;) while from the natural dryness of the soil or from the lack of proper and continuous cultivation the trees are much run down,—so much so in fact that a large num-

ber of them are afflicted with dry-rot. Add to this that they had not been pruned for years, while the top in places formed a perfect net-work of interlacing branches, and one can form some idea of the formidableness of the undertaking. It had been the desire of the writer to spray the whole orchard at least twice, but this plan had to be abandoned before the first two months were past. The reasons for this partial abandonment of the project were, unusual and continuous rains through the whole season, distance from the University, the impossibility of taking more time from class-room duties than was given, and last, and perhaps the most important, the failure of the owner to trim and cultivate the orchard sufficiently early, owing to numerous other duties. The rains of this season were most continuous, of a most provoking recurrence at times of spraying, and of unusual violence. Several days were devoted to this work at each of six distinct periods dating from the 7th of April to the 3rd of June, and rain fell heavily either during or at the end of each one of these separate periods. With these difficulties kept in view, the results of the spraying were most encouraging.

The orchard treated is of ten acres extent, a parallelogram in shape and is laid out according to the points of the compass, the rows running north and south having forty-two trees to the row, those running east and west when full having sixteen trees. At the north end of the orchard nineteen rows run east and west; in the remainder of the orchard the rows run north and south.

The rows at the north end of the orchard beginning from the north are: seven partial rows of Greenings, six full rows of Baldwins, six full rows of Winesaps. The rows making up the southern part of the orchard and running north and south are, four rows of Duchess on the west side, on the east side four rows of Greenings. The middle eight rows are of mixed Ben Davis, Geneton, seedlings and others.

Sprayings, When and How Given.

The first spraying was given on the 7th and 8th of April.

As the buds had not burst, the copper-sulphate solution was used, consisting of six pounds of copper-sulphate to forty-five gallons of water. As the orchard is partly on a steep hill side, the barrel was placed in a wagon, and was lashed firmly to a stout bar passing across the wagon-bed and nailed to it.

One man drove the wagon and managed the pump, the other sprayed the trees.

The pump was the "Bean," with a large upright, cylindrical air chamber, and left nothing to be desired. A finger protected by a glass plate in front of the pump registered the number of pounds pressure at any moment. The pump was screwed to two cross pieces and sat upon the bottom of the wagon, thus rendering the pumping less arduous than when it is fastened to the top of the barrel. A strongly wired, rubber 4-ply hose connected pump with barrel, while a heavy, unwired 3-ply rubber hose connected pump and nozzle. From the great size and height of many of the trees and from the nearness at which they were planted, fifty feet of hose was found none too long. A combination of two different lengths of small water pipe, fitted so as to screw onto the top of a ten foot extension nozzle of bamboo with water-pipe core, rendered it possible to reach the tops of the tallest trees from the ground, or failing this, from the wagon. With the air chamber on the pump keeping up the pressure for a minute or two, it was possible for one man to drive the wagon, work the pump, and from time to time stir up the Bordeaux vigorously with the hoe.

The nozzle used was the "Deming," of Salem, Ohio, and worked better than any other used.

The few rows sprayed on the 7th and 8th as well as on the 20th and 21st and 22nd of April proved conclusively that it would be impossible in the time at our disposal to spray the whole of the orchard several times, and it was decided to devote our attention to about one-half of it. To this end we selected all of the Greenings on the north of the orchard, all the trees of whatever character in the four rows along the west of the orchard, and all the trees of whatever description in the six rows along the east

of the orchard. By this means we covered all of the Greenings, all of the Duchess, and a number of the Baldwins, Winesaps, and two rows of the mixed Ben Davis, Genetons and seedlings. Owing to rains and to numerous other interruptions we had not finished spraying the first time till the 29th of April. By June 3rd we had given the part sprayed previously its second spraying, which terminated the work for the year. Every application, save that given the first time, consisted of Bordeaux Mixture. This was found necessary, as upon our second visit on April 20-22nd the buds were too much developed to permit using the copper-sulphate solution. During the May and June sprayings Paris Green and London Purple were added for the Codlin Moth, one-fourth pound to the barrel.

Results.

When it is considered that heavy rains followed every spraying during the season, that nearly one-half of the orchard remained unsprayed, that occasionally as much as three weeks intervened between consecutive sprayings, that only two applications were given any trees, and that branches from neighboring trees interlaced, the results were very gratifying. Only relative deductions could, however, be made, since no infested trees had been checked the previous fall. Nevertheless the orchard had suffered much from scab, a fact we had learned from visits paid it during that year.

Three "checks," or unsprayed trees, were left amongst the Duchess, four amongst the Greenings at the north, four amongst the Baldwins, and four amongst the Winesaps. No checks were left amongst the other trees, since the six sprayed rows to the east could be easily compared with the six unsprayed rows of them.

An examination was made of the Duchess trees early in the fall, and one made of the winter apples somewhat later. Amongst the sprayed Duchess not a scabby apple or leaf was seen. The three checks were likewise free from scab. No value could therefore be attached to the spray in this case. The immunity of the

for these experiments, as the trees were much run down and the trees was due mainly to the fact that this apple is little subject to scab anywhere, partly no doubt to their occupying the highest and dryest portion of the orchard. Results were better as regards the injury done by the Codlin Moth, for I was informed by very careful countings conducted by the Entomologist, Prof. Aldrich, *that not more than half as many wormy apples were found on the sprayed trees as upon those unsprayed.* Amongst the sprayed Greenings not a scabby spot was seen on fruit or leaf. Three of the checks bore no fruit this year. The fourth one showed considerable scab on both fruit and leaves while several scabby leaves were found upon the other three checks. Amongst the Baldwins the difference between sprayed and unsprayed leaves was even more marked. The four checks were very scabby in fruit and leaves; the sprayed trees were almost entirely free from scab. As to the Winesaps the results were not conclusive. Three of the checks bore no fruit at all; the fourth was very scabby. However, two of the trees in Row Six from the east were likewise very scabby, though this may be partly accounted for by their having received only one spraying and that an early one. The apples on the remaining unsprayed trees of this variety were very scabby. All of the other sprayed Winesaps were nearly free from scab, though this part of the orchard had been most subject to the disease the year before. On the southern part of the orchard, the four east rows showed almost no scab, Rows Five and Six showed a little more, while the next six unsprayed rows showed considerable scab here and there according to varieties. Many of these being seedlings or unknown and mixed varieties, no very definite deductions in their case could be made. It was evident here as elsewhere in the orchard, however, that the Bordeaux Mixture, well applied, had largely prevented the Apple Scab.

Cost of Spraying.

Very important points to be decided in this work, in order to cause spraying to be generally and voluntarily adopted, are: does it pay to spray, and what is the cost? The writer will not attempt to prove the first point in regard to the orchard selected

apples generally were small and inferior, the most of them being utterly unsalable. As an answer, however, it may be stated that where fine orchards have been treated, the results in dollars and cents have been most gratifying.

The cost will be now given. From this any fruit-raiser of intelligence can compute, knowing what amount of fruit an average large apple tree will produce, whether it pays to spray.

Cost of good pump, which will last with care at least five years, $25.00; for the year	$5.00
Hose, fifty feet	4.00
Nozzle	.75
Two whiskey barrels	4.25
Extension rod	1.50
Bluestone (sulphate of copper)	10.20
Barrel of lime	2.50
Oil, gloves, etc	.65
Labor of one man for 9½ days	14.25
Total	43.10

Number of trees sprayed twice, about four hundred and thirty-eight.

Cost per tree ..... .10

Of course in these calculations the hire of a team of horses, wagon and pumper is not taken into account, for it is presumed that every man who has an orchard is supplied with horses and wagon; and as most of the spraying can be done at intervals between the usual busy times of the farmer, he will not have to hire more than one man. Even this last expense can be avoided if he has a boy about the place large enough to drive the team and do the pumping. This estimate, it must be remembered, is based on only two sprayings. In most states three or four sprayings have been found more efficacious. If four sprayings were given the cost would approximate fifteen cents per tree. Most large trees bear several bushels of fruit yearly. From this it can be plainly seen whether spraying for Apple Scab "pays," especially when it is kept in mind that when you spray for this disease, you can at the same time by adding Paris Green or London Purple to the Bordeaux lessen the inroads of the Codlin Moth as well.

TITLES TO PLATES.

Plate I. Ready to Spray.

Plate II. Apples Gathered from a Single Tree, Showing in the Three Piles the First, Second, and Third-Class Apples, Graded as to Scab alone and not Considering Codlin Moth Injuries.

Plate III. Scabby Fruit and Leaves.